

# Soil Temperatures

**Soil** temperatures were monitored for a number of years at two soil depths: 4 inches and 20 inches. Between January 1960 and June 1965, soil temperatures were measured at the Arvin-Frick master agroclimate station. The soil at that site was Hesperia fine sandy loam. The land surface was planted to Goar's fescue (grass) and was irrigated as required to keep the grass green and growing well. A continuous trace of temperature at the 4-inch depth was obtained with one stainless steel sensor bulb of the California Spot Climate Recorder. Temperatures at the 20-inch depth were continuously recorded using a Dixon minicorder. Daily maximum and minimum temperatures were read from the circular recorder charts and tabulated. Monthly averages of maximum and minimum temperatures were calculated from the tabulations of daily data.

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The master agroclimate station was moved from Arvin-Frick to Old River 3-S in the fall of 1965. Soil temperatures were measured at Old River 3-S from November 1965 to December 1967. The land surface was planted to mixed pasture grasses, which provided 100 percent ground cover. Temperature measurements were made with the same equipment as used at Arvin-Frick.

Between August 1969 and June 1970, soil temperature data were collected at 4-inch and 20-inch depths at Bakersfield 10-S agroclimate station. The soil at this location was mapped as Foster loam. The land

surface was planted to mixed pasture grasses, which were maintained at about a 4- to 6-inch height by frequent mowing. The site was irrigated frequently during the summer months, but the pasture grasses were green and growing even during winter months.

For all stations, calibration of the temperature sensors was checked about twice each year by placing the sensor bulbs in water baths of various temperatures as determined with high-quality laboratory thermometers. The temperature sensors were reinserted in the soil at the proper depths following the

FIGURE 35

Average Soil Temperatures at 4-Inch Depth at Three Agroclimate Stations Near Bakersfield – 1960-1970

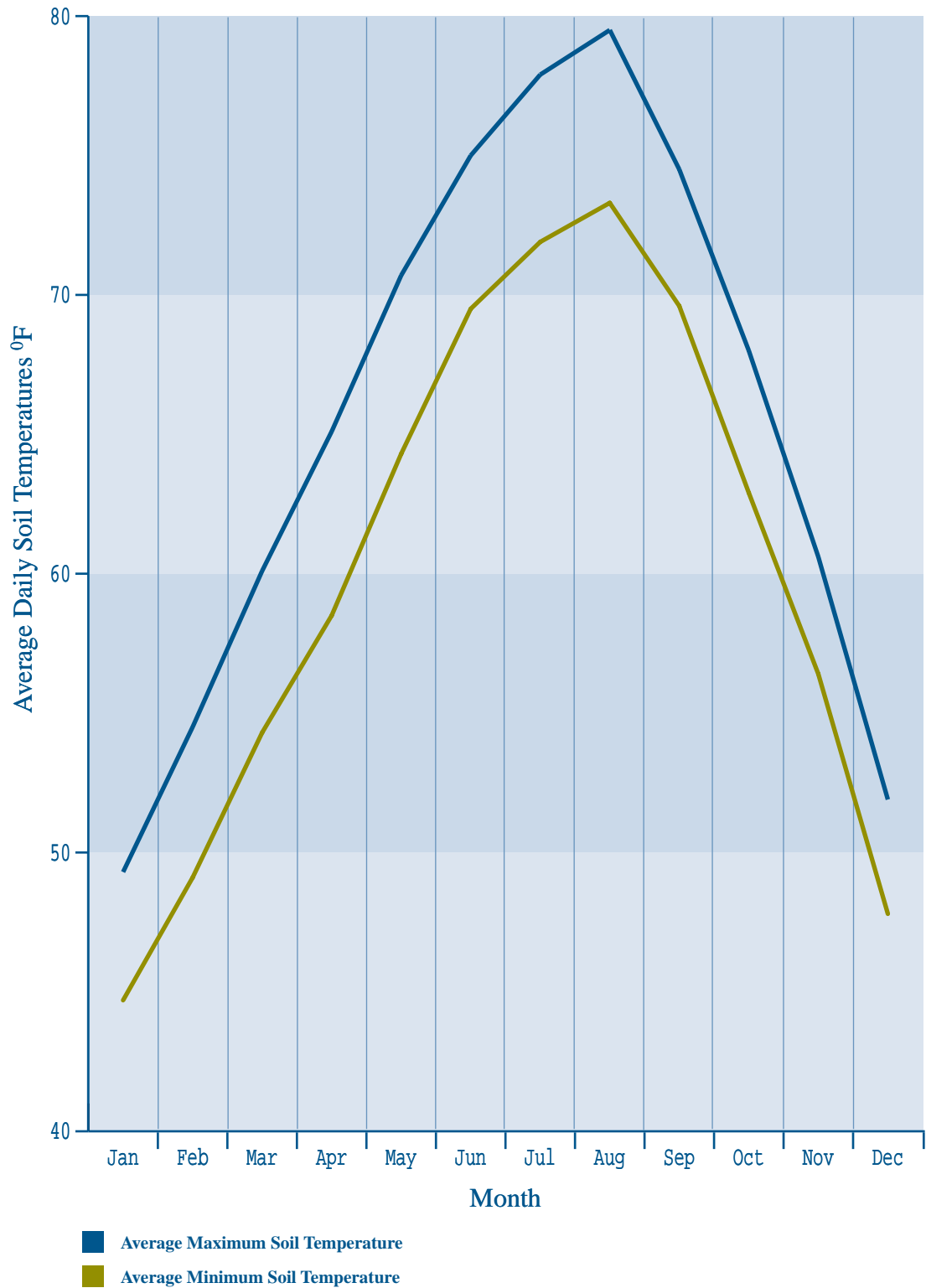


TABLE 49

### Soil Temperature (degrees fahrenheit)

Month	AT 4-INCH DEPTH <sup>1</sup>			At 20-Inch Depth
	Maximum	Minimum	Average	Average <sup>2</sup>
Jan	49.3	44.7	47.0	48.7
Feb	54.5	49.1	51.8	51.8
Mar	60.1	54.3	57.2	56.0
Apr	65.1	58.5	61.8	60.2
May	70.7	64.3	67.5	66.1
Jun	75.0	69.5	72.2	70.6
Jul	77.9	71.9	74.9	74.9
Aug	79.5	73.3	76.4	76.1
Sep	74.5	69.6	72.0	72.2
Oct	68.0	62.9	65.4	67.1
Nov	60.6	56.4	58.5	61.0
Dec	51.9	47.8	49.8	53.1
Mar-Oct Average	71.4	65.5	68.4	67.9
Jan-Dec Average	65.6	60.2	62.9	63.2

<sup>1</sup> Summarized from daily recorded temperatures at Arvin-Frick, Old River 3-S, and Bakersfield 10-S agroclimate stations 1960-1970.

<sup>2</sup> Average of all data collected at 10 agroclimate stations.

calibration checks. It appeared that the sensors quickly returned to thermal equilibrium with the soil.

### DATA ANALYSIS

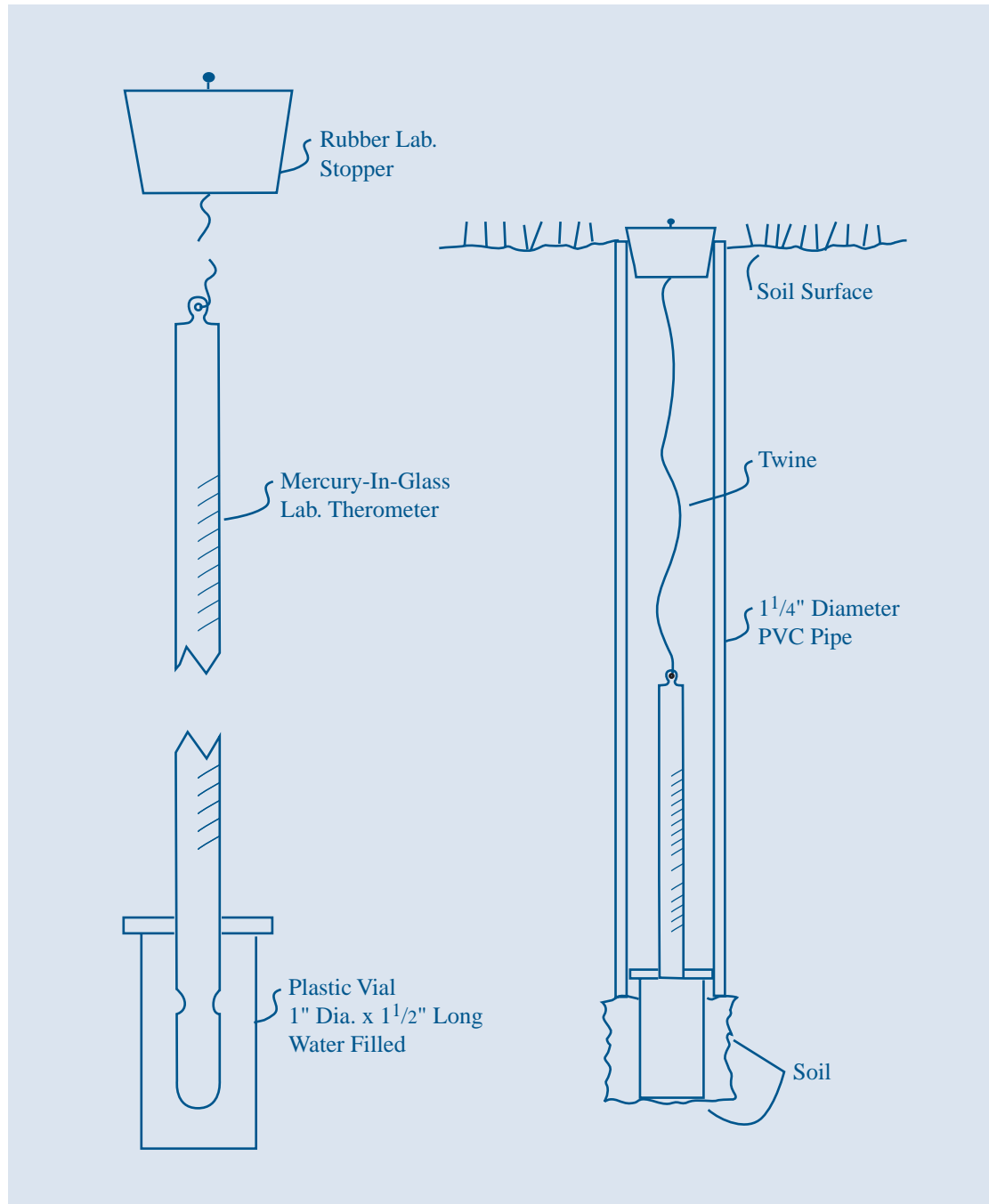
Examination of approximately eight years data collected between 1960 and 1970 showed the annual pattern of both maximum and minimum temperatures to be remarkably consistent for all three locations. Table 49 lists the average monthly maximum and minimum temperatures measured at 4-inch depth for three different irrigated pasture sites near

Bakersfield. Table 49 also shows the monthly mean temperatures (maximum + minimum %2) measured at 20 inches deep at ten outlying stations.

Figure 35 shows the average maximum and minimum soil temperatures at the 4-inch depth. The data plotted are the average for the three different pasture sites. The difference between maximum and minimum temperatures runs about 6° F during the principal growing season (March to October).

FIGURE 36

Kimball Soil Thermometer. Water Filled Vial Changes Temperature Very Slowly to Assure Accurate Thermometer Reading



During the four winter months (November to February), the difference is about 4.5° F. For the year, the difference is about 5.5° F.

The temperature charts show little diurnal fluctuation at the 20-inch soil depth. Therefore, only the average daily temperatures are shown for the 20-inch soil depth. The monthly means of daily temperatures at the 4-inch depth are about the same as the monthly average temperatures measured at the 20-inch depth. This close relationship is shown in Table 49.

Standard liquid-in-glass thermometers were adapted to measure temperatures at 20-inch (and deeper) soil depths, where there was little observable daily fluctuation. This thermometer modification was developed by Marston Kimball, Statewide Specialist in Bio-Climatology, University of California, Agricultural Extension Service (Figure 36).

During a five-year period (1965 to 1970), temperature data were collected at 20-inch depth at the two master stations and at seven outlying agroclimate stations.

Examination of those data showed little variation between different years at the same location and little variation between locations for the same year. Thus, the approximately 150 monthly averages were summarized into a single set of monthly values.

With the Kimball thermometer, temperature observations at the outlying stations were made only about once each week. The thermometers were read to the nearest 1° F. Differences from week to week at the same location ran about 1° F. The monthly values reported in Table 49 are the average of about four weekly observations.

Palmer maximum/minimum soil thermometers were installed at the same soil near the sensors for the California Spot Climate Recorder. Soil temperature data listed by specific location, month, and year are found in Tables 19 and 20 of the DWR San Joaquin District memorandum report entitled *Summary of Agroclimate Data Collected on the San Joaquin Valley Floor, 1959-1970*, dated January 1972.

Average soil temperature at 4 inches deep and 20 inches deep lags about 6 weeks behind peak solar radiation.

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